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Postprint / Postprint
Zeitschriftenartikel / journal article

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Empfohlene Zitierung / Suggested Citation:
Malmberg, B. (2010). Low fertility and the housing market: evidence from Swedish regional data. *European Journal of Population / Revue européenne de Démographie*, *26*(2), 229-244. https://doi.org/10.1007/s10680-009-9205-y

Low Fertility and the Housing Market—Evidence from Swedish Regional Data

Bo Malmberg

Basse fécondité et marché du logement- Une analyse de données régionales suédoises

Abstract

The long-term effect of low birth rates is a decline in the population share of children and young adults. How will such changes in age structure affect the housing market? In this paper, panel data sets for Swedish municipalities from 1981 to 2006 are used to answer this question. The use of panel data makes it possible to control for the effect of national-level policy shifts and macroeconomic events through the introduction of fixed time effects. The results show that population aging could to lead to less rapid house price growth in the first decades of the 21st century, compared to the last decades of the 20th. These results also hold when local population growth, income growth, and educational levels are controlled for.

Keywords: Housing market, age structure, low fertility

Résumé

A long terme, des taux de natalité faibles entraînent une baisse de la proportion d'enfants et de jeunes adultes dans la population. Quelles sont les répercussions possibles de ce changement de structure d'âge sur le marché du logement? Dans cet article, des données de panel provenant de municipalités en Suède et couvrant la période de 1981 à 2006 sont exploitées pour répondre à la question. L'utilisation de données de panel permet de contrôler l'effet des changements de politiques à l'échelle nationale et des événements macro-économiques par l'introduction d'effets temporels fixes. Les résultats indiquent qu'un vieillissement de la population pourrait ralentir la hausse du prix des logements au cours des premières décennies du 21e siècle, par rapport à celle des dernières décennies du 20e siècle. Ces résultats se

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maintiennent lorsque la croissance locale de la population, la hausse des revenus et l’élévation des niveaux d’instruction sont contrôlés.

Mots-clés: Marché du logement; Structure par âge; Basse fécondité

1 Introduction

A long-term effect of low fertility rates and increasing life expectancy is that populations become increasingly dominated by older age groups. This is illustrated in Figure 1, which shows the population share of people above and below 40 years in 22 OECD countries plus India and China. In 1950, those below 40 years of age outnumbered the 40+ group in all of these countries. In 2000, however, the 40+ group in Italy and Germany had reached an equal level with the below-40 group. By 2020, the below-40 age group will be outnumbered in Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. In 2020, the 40+ group will be smaller than the below-40 group only in China, India, Luxemburg, New Zealand, and the United States.

This paper explores the possibility that this shift in age structure will have a negative effect on house prices. A strong motive for exploring this link is that in most high-income countries, housing assets constitute an important part of total wealth (Englund and Ioannides 1997). For many households, it is the only major asset they hold. Thus, a close link between birth rates and housing values would entail substantial economic effects of low fertility on large population groups.

There are various reasons why age structure might have an effect on equilibrium house prices. One is that housing demand shifts over the life cycle because of age-related changes in income and housing preferences (Ermisch 1996; Green and Hendershott 1996). Another is that the income elasticity of housing demand may differ among age groups (Carliner 1973). It also possible that shifts in age structure indirectly affect housing demand by influencing per capita income growth, inflation rates, and taxation. In addition, there may be effects on housing supply because of age-structure-dependent shifts in labor supply and productivity. The framework of this paper, however, does not allow room for a detailed theoretical treatment of these mechanisms. Instead, the approach is to specify and estimate an empirical model that helps circumvent some of the problems involved in the identification of age effects in house price data.

Strong evidence for demographic effects on housing demand is presented in (Lindh and Malmberg 2008), in which it is argued that age effects in time series are more difficult to identify in price data than in volume data, since house prices are strongly influenced by tax rules and systems for housing subsidies that change over time, as well as by sudden shifts in the financial markets. This does not apply to the same extent with volume data. If, for example, property taxes are reduced by 50%, this is likely to raise the price of existing dwellings, irrespective of demographic change. The volume of housing demand will be less affected than house prices, however, since the increase in purchase price is compensated for by a lower user cost.

One way of trying to avoid the problem discussed by Lindh and Malmberg is to use regional panel data. The most important advantage of regional panel data is that fixed time effects can be used to account for movements in house prices that are associated with changing interest rates, tax rules, and housing subsidies. The use of time effects implies that year-by-year variation in the average age structure and average house prices is not used to estimate the age parameters. Instead, these are estimated using variation in age structure and house prices across regional units. For a similar argument, see (Levin et al. 2009).

Interest in the housing market effects of demographic change is not new, see (Campbell 1963; Easterlin 1965; Blanchet and Bonvalet 1985; and Ermisch 1988). In the most debated paper published in this field, Mankiw and Weil (1989) predicted that housing prices would fall sharply in the 1990s as a response to the aging of the American “baby boomers.” This was sharply criticized. The authors’ main mistake was to use cross-sectional micro-level data to estimate age-specific housing demand, a procedure that ignores the fact that, in a cross-section, housing consumption among the older generation is low due to low lifetime income (Green and Hendershott 1996). Demand values obtained in this way, in other words, do not give a good representation of how much housing the current active generation will consume when they retire, see (Myers 1999). When housing demand across age groups is properly estimated, either by controlling for different income levels in cross-section data or by using a cohort approach, the age profile becomes less dramatic, especially at higher ages. Nonetheless, there is clear evidence of changing housing demand over the life cycle (Ermisch 1996; Myers and Ryu 2008).

This paper, as with Lindh and Malmberg (2008), differs from the above-discussed papers by not using micro data to estimate housing demand. Instead, aggregate housing demand indicators are regressed on aggregate measures of age structure. The econometric use of age-distribution time series was pioneered by Fair and Dominguez (1991), but the method is not without problems. For example, the age data may display high levels of multicollinearity that lead to large standard errors in the estimates. Nonetheless, it has been used successfully in various contexts and has demonstrated an ability to generate statistically robust models (Croix et al. 2009; Lindh and Malmberg 1999). Compared to models based on cross-section, micro-level data, age-effect parameters estimated for longer periods from aggregate time series data should be less affected by cohort effects, since the estimate for a specific age bracket is based on observations representing different cohorts. It is important, however, not to interpret age-effect estimates from aggregate models as individual-level behavioral parameters. Instead, it is better to see them as estimates for a reduced-form model with parameters that reflect the combined effect of different mechanisms whereby age structure can influence a certain macro variable (Lindh 1999).

Interest in the effects of demographic change on the housing market has spurred several studies in recent years. In a study of US metropolitan areas, Judd and Winkler (2002) found population change to be a major explanation for house price growth. In a paper on the macroeconomic effects of population aging, Davis (2005) found age structure to be an important determinant of house price trends in seven major OECD countries. Egert and Mihaljek (2007), in a study of house prices in Central and Eastern Europe, concluded that age structure plays an important role in house price dynamics. For Germany, Maennig and Dust (2008) reported a strong negative effect of population decline on house prices. A recent study by Levine et. al. (2009) reports similar findings to those presented below, using a similar approach to estimating age effects.

The view taken in this paper is that individual-level and macro-level approaches are complementary. If only individual-level data are relied upon, there is a risk that economic phenomena resulting from the interaction between economic actors cannot be accounted for. In aggregate data, on the other hand, problems of multi-collinear and non-stationary data can make estimates less reliable. There is also a risk that relationships estimated on historical data will turn out to be short-lived and, therefore, of little use in predicting future trends. This is why the view taken in this paper is that the two approaches are complementary. Valid inferences on the effects of age structure change should be based on a careful consideration of the results from studies using individual as well as aggregate data. The paper at hand uses the aggregate approach; thus, its results should weighed against studies that takes advantage of the rich range of information contained in micro-databases.

2 A Model outline

The object of the section below is to sketch a model that can help interpret the estimation results.
Average house prices p can be expressed as

$$p = \frac{px}{x} \qquad (1)$$

where x is the number of housing units and px is the total demand for houses. To derive house price changes as a function of age structure, $p_t x_t$ can be defined as:

$$p_t x_t = \sum q_i n_{i,t} \qquad (2)$$

where q_i is the age-specific demand for housing per individual in age group i, and $n_{i,t}$ is the number of individuals in age group i at time t. The movement equation for $n_{i,t}$ is:

$$n_{i,t+1} = \eta_i * n_{i,t} \Leftrightarrow \Delta n_{i,t} = (\eta_i - 1) n_{it} \qquad (2a)$$

where η_i is the survival rate of the cohort.
The determinants of q_i are income and the share of income that different age groups allocate to housing.

$$q_i = \rho_i y_{i,t}$$

Changes in housing demand over time can be obtained by differencing (2) with respect to time:

$$\Delta_t px = \sum \Delta_t q_i * n_{i,t} + \sum q_i * \ \Delta_t n_{i,t} =$$
$$\sum \Delta_t y_i * \rho_i * n_{i,t} + \sum y_{i,t} * \Delta_t \rho_i * n_{i,t} + \sum q_i * \ \Delta_t n_{i,t} \qquad (3)$$

This expression consists of three parts: (1) changes in housing demand because of changes in the share of income allocated to housing: $\sum y_i * \Delta_t \rho_i * n_{i,t}$, where $\Delta_t \rho_i$ is the change in housing demand due to the aging of an individual; (2) changes in housing demand because of changes in income: $\sum \Delta_t y_i * \rho_i * n_{i,t}$, where $\Delta_t y_{i,t}$ is the change in income for age cohort $n_{i,t}$; (3) changes in housing demand because of changes in the size of the cohort: $\sum q_i * \ \Delta_t n_{i,t}$

If x is constant, then:

$$\Delta_t px = \Delta_t p * x$$

Now assume that the number of existing housing units is proportional to the population:

$$x = \varphi * N$$

where N is population size, and φ is a constant. Then the growth rate of house prices can be expressed as:

$$\frac{\Delta p}{p} = \frac{\Delta_t p * x}{p * x} = \frac{\Delta_t p * x}{p * \varphi * N} =$$

$$\frac{\sum \Delta_t y_i * \rho_i * n_{i,t}}{p * \varphi * N} + \frac{\sum y_{i,t} * \Delta_t \rho_i * n_{i,t}}{p * \varphi * N} + \frac{\sum q_i * \ \Delta_t n_{i,t}}{p * \varphi * N} \qquad (4)$$

Now, if it is the case that the growth of cohort $n_{i,t}$ is proportional to the size of the cohort $n_{i,t}$, then (4) can be rewritten:

$$\frac{dp}{p} = \frac{1}{p}\sum \beta_i * \frac{n_{i,t}}{N},$$

$$\text{where } \beta_i = \frac{\Delta_t y_i \rho_i + y_{i,t}\Delta_t \rho_i + q_i(\eta_i - 1)}{\varphi} \tag{5}$$

and η_i is the parameter that links cohort growth to the size of the cohort.

What can now be said of the different components of (5)? The likely shape of $\Delta_t y_i \rho_{ii}$ is that it is positive up to about age 50 and then approaches zero. It may also become negative. The shape of $y_{i,t}\Delta_t \rho_i$, according to micro-level studies, increases up to about age 50 and then stays constant. For most age groups, $(\eta_i - 1)$ could be close to zero but when mortality increases, it will become increasingly negative.

The derivation of expression (5) presupposes that there is no change in the housing stock. Although this is not realistic, the assumption can be defended if it is acknowledged that the supply of urban land in attractive locations has a very low elasticity. Moreover, the hypothesis that changes in house prices are driven by shifts in demand can be tested. Demand-driven price changes imply that increases in the housing stock are positively correlated with prices, whereas supply-driven price changes imply a negative correlation.

3 Data and estimation

3.1 Data

Data on house prices in this study are based on the mean purchasing price for one- and two-family buildings used as permanent residences in Swedish municipalities. This series, which starts in 1981, had data up to 2006 when this study was initiated. For 278 of the municipalities in the country, Statistics Sweden has a complete time series from 1981 to 2006 (26 observations). The length of the time series goes someway towards alleviating the problem of cohort effects. In 1981, people in the 50-64 age bracket represent individuals born 1917-1931. In 2006, this group consists of individuals born 1942-1956. The estimates for the 50-64 age group, thus, represent the average effects of cohorts that have faced rather different conditions during their lives.

The mean annual change in nominal house prices over this period has been 2.1%. Over the same period, the annual change in consumer prices has been 4.0%. However, the unfavorable development of house prices relative to consumer prices was a characteristic only of the early 1981 to 1994 period. During the last ten years, house price increases have been 2.5% per year but CPI has increased 1.1 percent per year.

The demographic data from Statistics Sweden is based on a continuously updated population register. The yearly data reflect the situation of December 31 each year. The population has been divided into six groups: ages 0-14, 15-29, 30-49, 50-64, 65-74, and 75+. This division corresponds to the age bracket used in Lindh and Malmberg (2008). The age variables are entered as population shares. The intercept has been dropped from the model to avoid singularity.

Data on educational levels and income have also been taken from Statistics Sweden. Educational data are available from 1985 and income data (mean non-capital income of people aged 20+ years) at the municipal level from 1991. The education indicator chosen for this paper was the share of population aged 16-74 years with a background of tertiary education. Descriptive statistics are given in Table 1 and Figure 2.

3.2 Estimation

The model derived in the above will guide the statistical estimation. Thus, the model estimated is

$$\log \frac{p_t}{p_{t-1}} = \sum_i \beta_i \frac{n_i}{N} * \frac{1}{p_t} + \sum_j \gamma_j x_j + \varepsilon$$

where i = (0-14, 15-29, 30-49, 50-64, 65+),

j = (1981-2006),

$\frac{n_i}{N}$, is the population share of age group i

$\frac{1}{p_t}$, is a normalization of the age share based on current

house prices,

$$x_j = \begin{bmatrix} 0, & if \quad j \neq t \\ 1, & if \quad j = t \quad and \quad j < 2006 \\ -1, & if \quad j = t \quad and \quad j = 2006 \end{bmatrix}, \text{ and}$$

β_i and γ_j are the parameters to be estimated. (6)

It will be assumed that the age parameters β_i are constant over time and across regions. This is a simplifying assumption. Lower old-age mortality will, for example, change the age profile of η_i, and changing career patterns may change the age profile of ω_i. The estimated age parameters, thus, will reflect the average values of these age profiles over the estimation period. This should be taken into account especially if the estimated model is used for long-term projections. The dependent variable used in this study is the first-differenced log mean purchasing price for one- and two-family buildings. By using the first differenced log prices, quality differences between dwellings across municipalities that are constant over time are controlled for, as well as constant differences in the level of house prices across regions. Using first differences can also help eliminate non-stationarity in the house price time series (Hort 1998).

All the estimated models include time dummies, which helps eliminate the potential effect of macroeconomic events on house prices. These events include an inflationary economy during the second half of the 1980s, a major tax reform in 1991 that increased the

net interest paid on mortgages, a deep economic recession in 1991-1994, the IT boom of the late 90s, and a period of fast income growth in the early 2000s.
One way to check the validity of the age model is to introduce controls. If age effects are still present when regional factors such as income, education, and population growth are controlled for, this fact will strengthen the argument that age structure as such plays a role in the housing market. Thus, when the age model has been estimated, this will also lead to an analysis of how the introduction of controls affects the results.
The basic age model is estimated on data for the 1982-2006 period. Since the control variables are not available back to 1982, the more elaborate model has been estimated on a shorter period, 1991-2006. This may reduce the amount of between-municipality variation in age structure and, hence, produce weaker estimates. But given that there are observations for 15 different years across 290 municipalities, this is not necessarily an overwhelming problem.

4 Estimation results

The results from estimating the basic model are presented in Table 2 (column 1) and Figure 3. As can be seen from the table, there are significant positive effects on house price changes in the 15-29 year and 30-49 year age groups, and a significant negative effect on house price changes in the 75+ age group. This pattern is very similar to the effects that Lindh and Malmberg (2008) found on residential construction in both Swedish and OECD data.

A Breusch-Pagan test of the residuals shows that there is significant heteroskedasticity in the residuals. One explanation for this is that the number of house sales varies between large and small municipalities, and that a small number of sales can increase random price variability. It is also the case that municipalities with age structures that deviate substantially from the average age structure tend to display a larger variation in house price growth over time. Most of these municipalities are located close to the major Swedish metropolitan areas and some are located in areas that have suffered large population declines over the last decades. The presence of heteroskedasticity suggests that a weighted regression, in this case, should be preferred to OLS. Column 2 in Table 2 shows the estimation obtained using weights based on the number of sales and on how much the age structure deviates from the national mean. Using weights makes the point estimates for the 15-29 and 30-49 age groups somewhat larger and the point estimate for the 65+ group somewhat smaller. There is also a slight increase in the standard errors.

The residuals of this model also indicate the presence of negative autocorrelation. The Durbin-Watson statistics for panel data (Bhargava et al. 1982) is 2.53. This suggests that a lag model should be considered (Englund and Ioannides 1997). Table 2, Column 3, thus, provide estimates obtained using time lags (and weights). The number of observations is lower here, and Column 4 gives estimates for the non-lag model for the same time period. The results show that the inclusion of lags leads to somewhat lower standard errors and an increase in the size of the point estimates. On the other hand, including lagged dependent variables may lead to dynamic bias (Bun and Carree 2005).

The fifth column in Table 2 shows the effect of introducing regional fixed effects. This leads to a large increase in the size of the 0-14 and 15-29 estimates and a reversal of the sign for the 30-49 age group. There is also, on average, a doubling of the standard errors of the age effect estimates. Such increases in the standard errors are a clear sign that the inclusion of regional fixed effects leads to severe multicollinearity (Maddala 2001).

The results thus far show very clear age group effects. The estimates indicate that households increase their demand for housing as their incomes rise during the early stages of working life. After the age of 50, the income elasticity of housing demand declines, and after retirement, declining incomes lead to a decline in housing demand.

It could be argued that the age models estimates above leave out fundamental determinants of housing demand, such as income growth, population growth, and education levels. For these variables, only data from 1991 to 2006 have been available. That is, the sample periods will be different and, as shown in Figure 3, changes in the sample period have an effect on the estimated demand profile. The largest effect is found on the 30-49 age group, where the parameter estimate for the 1986-2006 sample is nearly three times higher and the 1982-2006 estimate nearly two times higher than the estimate for the 1991-2006 sample. The estimate for the 0-14 age group, on the other hand, is larger for the 1991-2006 sample. This indicates that the rapid Swedish post-1991 fertility decline has changed the way different age groups correlate with housing demand.

The effects of including control variables are shown in Table 3, where the estimates for the 1991-2006 sample are presented with and without control variables. All these models use weighted observations. First, it can be noted that in the 1991-2006 sample, the estimate for the 30-49 age group is no longer significant. Furthermore, the estimates show that an inclusion of income growth has relatively small effects on the age estimates. Controlling for the share of working age population with higher education has a stronger effect, especially for the 15-29 and 30-49 age groups, and when a control for population growth is included, the negative effect of the 65+ group becomes smaller. Apart from the last model, however, there is a clear negative effect of aging. This can be tested in the following way: if there was no negative effect of aging, then the sum of the 0-14, 15-29, and 30-49 estimates, minus the sum of the 50-64 and 65+ estimates, should not be significantly different from zero., This is not the case, however. For the model excluding population growth, this sum is 0.171, with a standard error of 0.060. That is, there is evidence of a negative effect of population aging on house price growth even with controls for income growth and share of individuals with higher education.

Finally, does ignoring the effect of changes in housing supply potentially invalidate the analysis we have presented here? One answer to this is given in the last column of Table 2, where the growth rate of new one- and two-family dwellings has been included among the regressors. This variable has a strongly significant effect on house prices but the effect is positive, not negative, which would be expected from a standard demand and supply framework. The reason for this positive estimate is probably that housing construction is stimulated by price increases, and that a high level of housing construction, thus, is the result of demand increases on the local level that the age model does not capture.

5 Discussion

One argument against using estimates based on regional data for projecting future housing demand would be that the age estimates do not represent true age effect but, instead, reflect the effect of net migration on age structure. This argument is supported by Table 4, where the age structure of municipalities with different net migration experiences are compared.

As can be seen in this table, regions with high shares in the 15-29 and 30-49 years age group are typically regions that have experienced in-migration. This follows from the fact that most migrants tend to be young adults. Conversely, regions with high shares of people above 65 years of age are typically regions that have experienced high rates of out-migration. Moreover, regions attracting young adults are mainly metropolitan areas, whereas regions that have lost population due to out-migration tend to be more peripheral.

This link between net migration and age structure does not, however, contradict the existence of age-structure effects on housing demand. To the contrary, a strong correlation between positive net migration and house price growth is exactly what one would expect from the age effect estimates presented here.

6 Conclusions

In an earlier paper, it was shown that residential construction (as a share of GDP) is positively influenced by a large young adult population but depressed when the share of older age groups is large (Lindh and Malmberg 2008). In this paper, this finding is complemented by statistical evidence from Swedish regional panel data indicating that an increasing old-age population tends to depress the rate of increase in house prices. By using regional panel data, it has been possible to eliminate the influence of shifts in the national-level macroeconomic situation, in national-level housing and tax policy, and in national-level financial conditions on house prices. Moreover, it has been shown that the influence on house prices is not only due to correlations between age structure and regional population growth, income growth, and levels of education. Instead, the depressing effect of a growing old-age group on house price increases may be related to higher death rates in the old age group and to increasing housing expenditure in the young adult group.

A limitation in the results presented above is that they are based on an analysis of differences in house-price trends across regions. This raises the question of whether the results can be used to forecast future time trends. However, the aggregate trend toward population aging implies that, in the future, there will be an increasing number of regions with high population shares of old people. And it is in these regions that house prices will be most negatively affected, especially if population aging is not compensated by high rates of population growth, income growth, or high shares of people with tertiary education. In regions that continue to attract young adults, house price increases could be expected to be higher. But given that the total young adult population is expected to decline in many countries, there will be relatively few regions that can expect this more positive trend.

A further limitation of the paper is that there has been no analysis of the possible effects of shifts in housing behavior across birth cohorts. For example, lower old-age mortality may reduce the negative effect on housing demand of a large old-age population. A clarification of this issue, however, must be left to future research.

Table 1. Descriptive statistics

	max	median	min	Mean	Std Dev	N
0-14	0.290	0.188	0.097	0.188	0.020	7430
15-29	0.249	0.183	0.114	0.182	0.021	7430
30-49	0.355	0.267	0.196	0.267	0.016	7430
50-64	0.271	0.177	0.073	0.179	0.030	7430
65+	0.337	0.192	0.044	0.188	0.049	7430
Price growth	0.329	0.024	-0.226	0.022	0.044	7125
Income growth	0.096	0.035	-0.008	0.035	0.010	4311
Pop growth	0.206	0.000	-0.322	0.000	0.011	7450
Percent with higher education	0.590	0.152	0.057	0.169	0.073	6036
Growth, houses	0.067	0.001	-0.019	0.004	0.006	4640
1/p	1.172	1.013	0.788	1.005	0.067	7430

Table 2. Age effects on house prices, 1982-2006 (standard errors in parentheses); the dependent variable is change in log house prices

	Base, no weights	Base, weights	Lag sample, lags	Lag sample, no lags	Regional
	1982-2006	1982-2006	1986-2006	1986-2006	1986-2006
0-14	-0.0522	-0.0134	-0.0077	-0.0087	0.2760
	(0.0304)	(0.0316)	(0.0333)	(0.0352)	(0.0773)
15-29	0.0976	0.1078	0.1231	0.0947	0.2673
	(0.0272)	(0.0282)	(0.0292)	(0.0307)	(0.0539)
30-49	0.1006	0.0868	0.1617	0.1295	-0.1151
	(0.0316)	(0.0332)	(0.0359)	(0.0376)	(0.0685)
50-64	0.0193	-0.0130	-0.0624	-0.0443	-0.0208
	(0.0291)	(0.0307)	(0.0319)	(0.0336)	(0.0440)
65+	-0.0898	-0.0870	-0.1142	-0.0919	-0.1339
	(0.0140)	(0.0149)	(0.0150)	(0.0156)	(0.0477)
$\Delta p(-1)$			-0.3289		-0.4217
			(0.0130)		(0.0134)
$\Delta p(-2)$			-0.0369		-0.1558
			(0.0136)		(0.0145)
$\Delta p(-3)$			0.0645		-0.0475
			(0.0136)		(0.0143)
$\Delta p(-4)$			0.0362		-0.0364
			(0.0128)		(0.0131)
R-square	0.319	0.377	0.458	0.395	0.514
Time effects:					
F-value	125.96	161.79	608.74	608.31	559.12
Df	24	24	20	20	20
N	7125	7125	5970	5970	5838
Sum of weights		1159878	985389.2	985389.2	973935.7

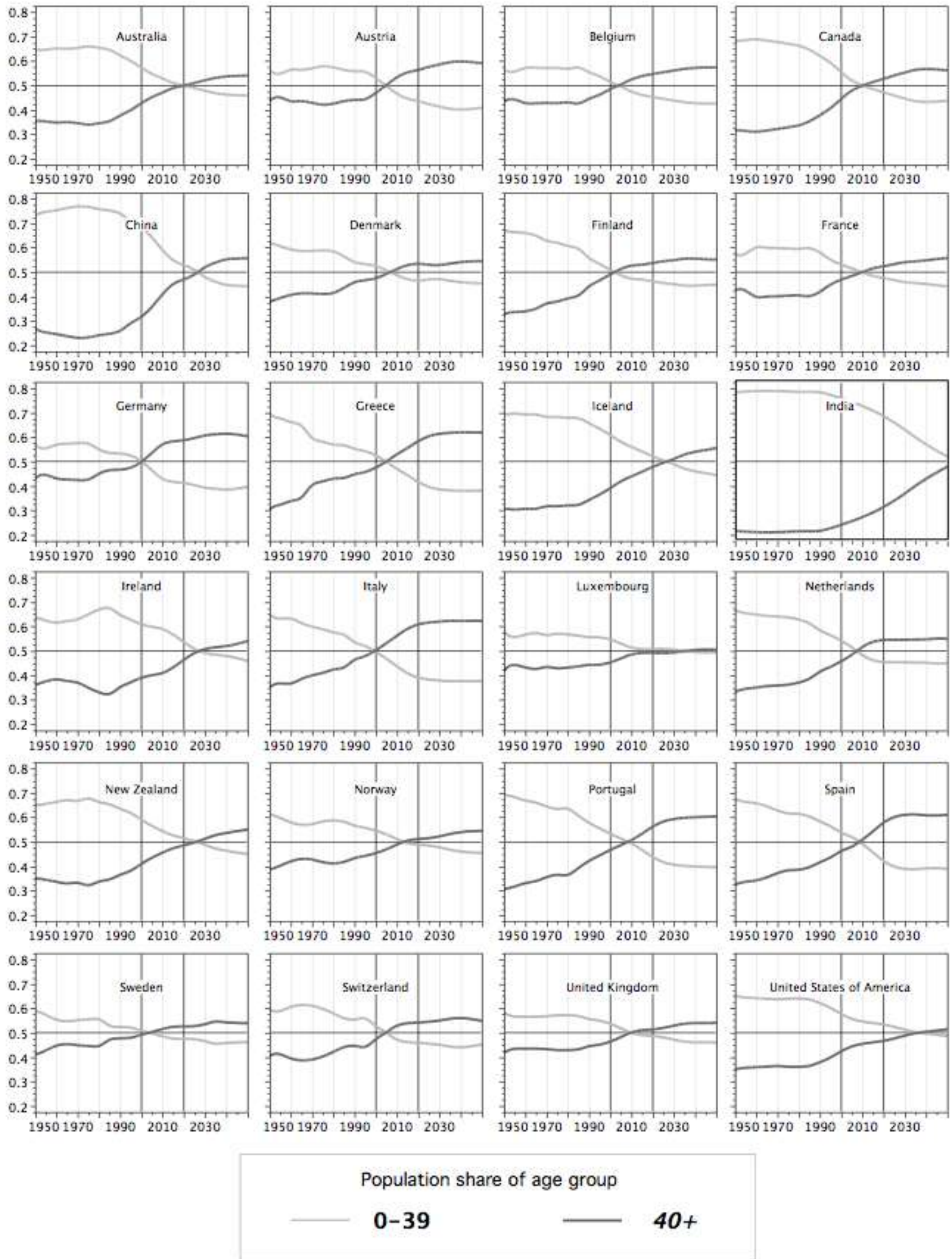
Table 2 Age effects on house prices, 1991-2006, with controls. Standard errors in parentheses; the dependent variable is change in log house prices.

	1	2	3	4	5
0-14	0.0525	0.0119	0.0603	0.0397	0.0543
	(0.0454)	(0.0456)	(0.0470)	(0.0470)	(0.0452)
15-29	0.1164	0.1035	0.0637	0.0615	0.1275
	(0.0365)	(0.0364)	(0.0375)	(0.0374)	(0.0364)
30-49	0.0327	0.0261	-0.0368	-0.0472	-0.0184
	(0.0485)	(0.0483)	(0.0505)	(0.0504)	(0.0493)
50-64	-0.0202	-0.0300	-0.0177	0.0087	-0.0047
	(0.0400)	(0.0398)	(0.0399)	(0.0401)	(0.0399)
65+	-0.0962	-0.0985	-0.0663	-0.0389	-0.0639
	(0.0184)	(0.0184)	(0.0199)	(0.0205)	(0.0193)
Income		0.3959	0.3386	0.3364	
		(0.0649)	(0.0662)	(0.0660)	
Higher education			0.0443	0.0293	
			(0.0105)	(0.0109)	
Pop. growth				0.3825	
				(0.0750)	
Growth, houses					0.0543
					(0.0452)
R-square	0.341	0.346	0.349	0.353	0.345
Time effects:					
F-value	82.0092	83.7507	72.4782	74.4546	84.3431
Df	14	14	14	14	14
N	4305	4305	4305	4305	4305
Sum of weights	706151	706151	706151	706151	706151

Table 4. Population age structure in Swedish municipalities by net migration rate. Averages for the 1981-2006 period

	Population share of age group					
	0-14	15-29	30-49	50-64	65-74	75+
Net migration rate						
–13.0 to –3.1	18.0	17.5	25.6	18.6	10.8	9.5
–3.0 to -1.2	18.9	17.8	26.0	17.9	10.2	9.3
–1.1 to 1.2	18.9	18.4	26.4	17.7	9.8	8.8
1.3 to 4.4	19.3	18.6	27.6	17.5	9.1	7.9
4.4 to 18.2	19.3	18.7	27.9	17.3	9.0	7.9

Figure 1. Population share for 0-39 and 40+ age groups, 22 OECD countries plus China and India



Source: UNITED NATIONS (2007) *World Population Prospects: The 2006 Revision*, New York, United Nations, Population Division.

Figure 2. Box plots showing change over time in municipal-level population shares of the age groups 0-14, 15-29, 30-49, 50-64, 65-74, and 65+, population growth, share of individuals with higher education, income growth, and house prices

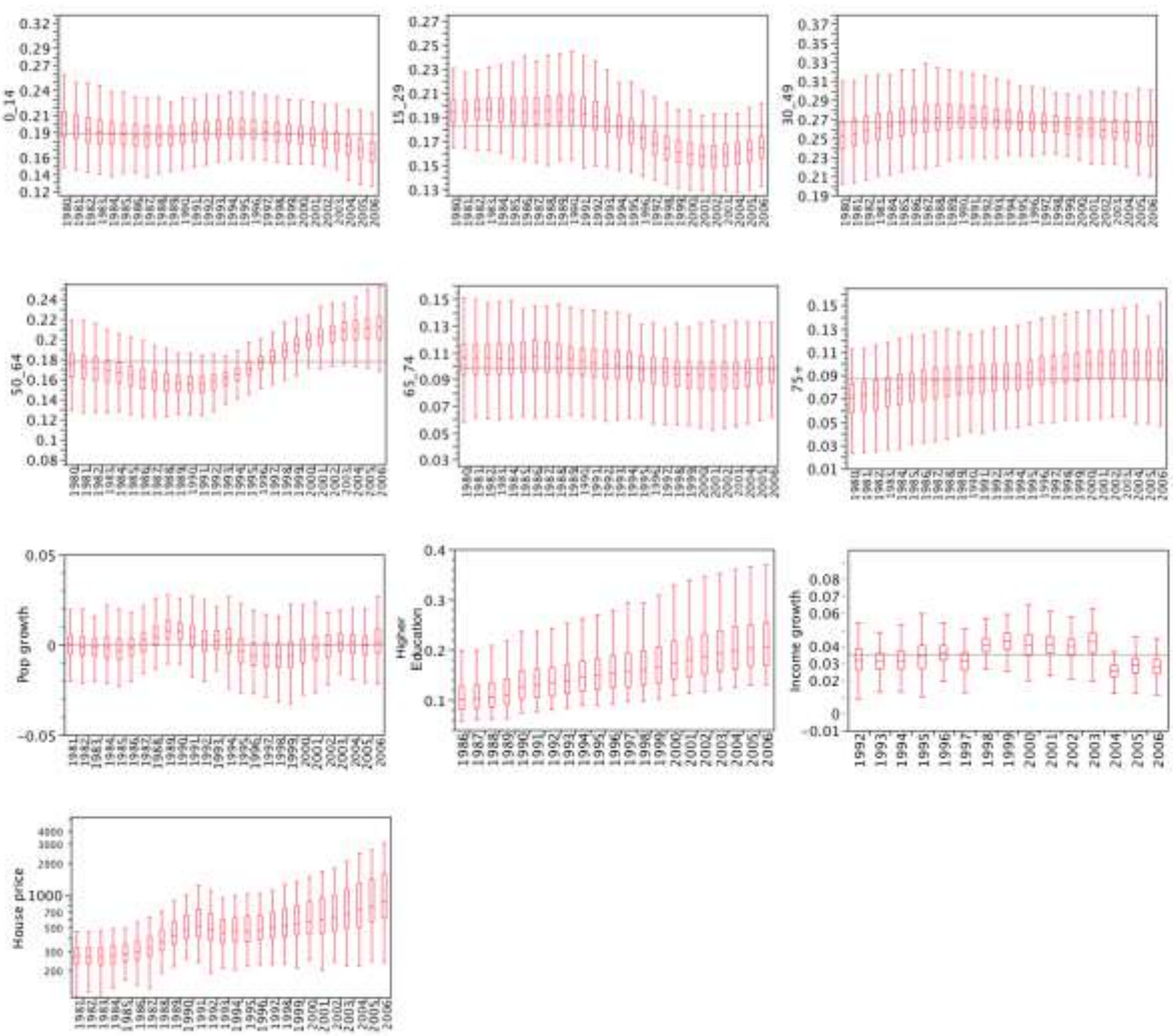
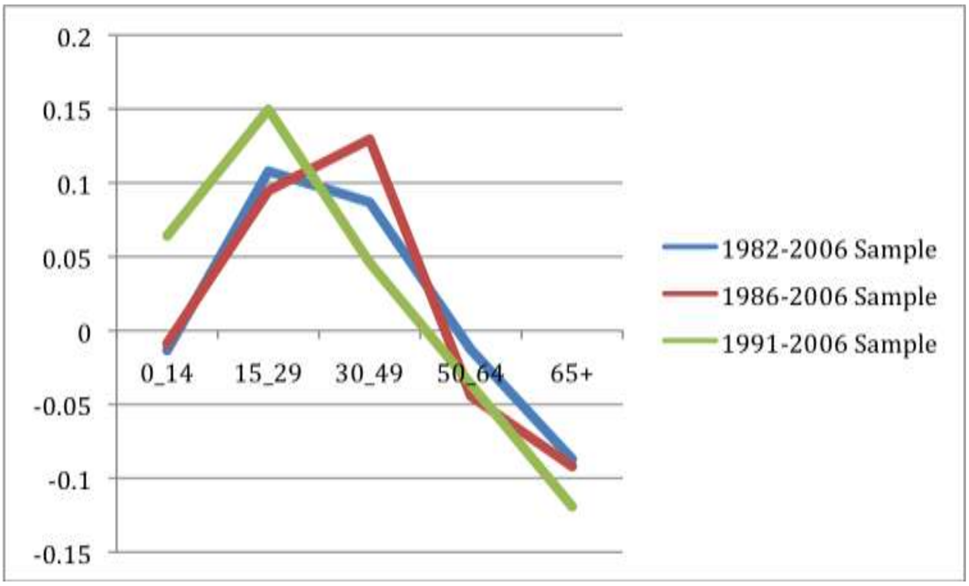


Figure 3. Estimated age effects on house prices, 1981-2006, 1986-2006, and 1991-2006 samples, weighted estimates



References

Bhargava, A., Franzini, L., & Narendranathan, W. (1982). Serial-correlation and the fixed effects model. *Review of Economic Studies, 49*(4), 533-549.

Blanchet, D., & Bonvalet, C. (1985). Croissance demographique et marche du logement en France depuis 1954. *Population (French Edition), 40*(6), 911-935.

Bun, M. J. G., & Carree, M. A. (2005). Bias-corrected estimation in dynamic panel data models. *Journal of Business & Economic Statistics, 23*(2), 200-210.

Campbell, B. O. (1963). Long swings in residential construction: The postwar experience. *The American Economic Review, 53*(2), 508-518.

Carliner, G. (1973). Income elasticity of housing demand. *Review of Economics and Statistics, 55*(4), 528-532.

Croix, D. d. l., Lindh, T., & Malmberg, B. (2009). Demographic change and economic growth in Sweden: 1750–2050. *Journal of Macroeconomics, 31*(1), 132–148

Davis, E. P. (2005). Challenges posed by ageing to financial and monetary stability. *Geneva Papers on Risk and Insurance-Issues and Practice, 30*(4), 542-564.

Easterlin, R. A. (1965). Long swings in U.S. demographic and economic growth: Some findings on the historical pattern. *Demography, 2*, 490-507.

Egert, B., & Mihaljek, D. (2007). *Determinants of house prices in central and Eastern Europe*: CESifo GmbH.

Englund, P., & Ioannides, Y. M. (1997). House price dynamics: An international empirical perspective. *Journal of Housing Economics, 6*(2), 119-136.

Ermisch, J. (1988). Changing demographic patterns and the housing market with special reference to Great Britain. In R. D. Lee, W. B. Arthur & G. Rodgers (Eds.), *Economics of Changing Age Distributions in Developed Countries*. Oxford: Clarendon Press.

Ermisch, J. (1996). The demand for housing in Britain and population ageing: Microeconometric evidence. *Economica, 63*(251), 383-404.

Fair, R. C., & Dominguez, K. M. (1991). Effects of the changing U.S. age distribution on macroeconomic equations. *American Economic Review, 81*(5), 1276-1294.

Green, R., & Hendershott, P. H. (1996). Age, housing demand, and real house prices. *Regional Science and Urban Economics, 26*(5), 465-480.

Hort, K. (1998). The Determinants of Urban House Price Fluctuations in Sweden 1968-1994. *Journal of Housing Economics, 7*(2), 93-120.

Jud, G. D., & Winkler, D. T. (2002). The dynamics of metropolitan housing prices. *Journal of Real Estate Research, 23*(1/2), 29-46.

Levin, E., Montagnoli, A., & Wright, R. E. (2009). Demographic change and the housing market: Evidence from a comparison of Scotland and England. *Urban Studies, 46*(1), 27-43.

Lindh, T. (1999). Age structure and economic policy: The case of saving and growth. *Population Research and Policy Review, 18*(3), 261-277.

Lindh, T., & Malmberg, B. (1999). Age structure effects and growth in the OECD, 1950-1990. *Journal of Population Economics, 12*, 431-449.

Lindh, T., & Malmberg, B. (2008). Demography and housing demand—What can we learn from residential construction data. *Journal of Population Economics, 21*(3), 521-539.

Maddala, G. S. (2001). *Introduction to econometrics* (3. ed ed.). New York ; Chichester: Wiley.

Mankiw, G. N., & Weil, D. N. (1989). The baby-boom, the baby bust and the housing market. *Regional Science and Urban Economics, 19*, 235-258.

Maennig, W., & Dust, L. (2008). Shrinking and growing metropolitan areas asymmetric real estate price reactions? The case of German single-family houses. *Regional Science and Urban Economics, 38*(1), 63-69.

Myers, D. (1999). Cohort longitudinal estimation of housing careers. *Housing Studies, 14*(4), 473-490.

Myers, D., & Ryu, S. (2008). Aging baby boomers and the generational housing bubble: Foresight and mitigation of an epic transition. *Journal of the American Planning Association, 74*(1), 17-33.